

# **Appendix 5-K**

## **Wild Horse Ridge**

### **Tank Seam Pad And Access Road**

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0063  
Refer to Record No. CO150025, 2006, Incoming  
in for additional information

## **Introduction**

This Appendix discusses the construction of the Wild Horse Ridge Tank Seam access road and portal pad. (Areas TS-16 and TS-17 on Plate 2-3G) Cut and Fill volumes have been determined for the road and pad and are summarized in Tables 5K-1 and 5K-2. Also included is an operational slope stability analysis and a reclaimed slope stability analysis. Pre-mining, Operational and Post-mining cross-sections are detailed in Attachment B of this Appendix. The as built slopes are at the same angle as the design analysis for slope stability.

## **TS-16 Constructions Description**

Construction in this area will included the widening of the switchback and adding two passing areas in the road. Construction ~~will begin~~ began at the switchback and the material cut out of the side of the mountain to widen the turn ~~will be~~ was used just below the switchback and in the area around cross-section 4 to widen the road in these areas. Topsoil ~~will be~~ was recovered to a depth of 6-10 inches from the areas where the road ~~will~~ was widened generating approximately 124 cu. yd. of material. The topsoil generated at the switchback was used at the same slope.

The area included in TS-16 will not be reclaimed but will be used for post mining access to the hunting cabin as described on page 4-7. During construction silt fences will be used below all cut and fill areas. Upon completion of construction all disturbed slopes will be covered with erosion control matting and reseeded (See Appendix 7-K). Cut slopes, fill slopes, and fill placement will follow the recommendations given in the Slope Stability analysis and report, included in Attachment B. A summary of the cut and fill volumes is shown Table 5K-1. Cross-Sections are shown in Attachment A.

Table 5K-1

TS-16 Summary of Cut and Fill

Cross Section	Cut Vo. (Cu Yds.)	Topsoil (Cu Yds.)	Fill Vol. (Cu Yds.)	Excess (Cu Yds.)	Amount Hauled	Avg Haul Dist. (Ft)	Cum. Vol. (Cu Yds.)
1	830 <u>1,982</u>	~36	139 <u>1,291</u>	655 cut	161	450	-655
2	431 <u>741</u>	~28	550 <u>860</u>	147 Fill	-0-	-0-	-508
3	52	~30	319	297 fill	-0-	-0-	-211
4	35	~30	161	156 fill	-0-	-0-	-55
<b>Totals</b>	<b>1,348</b> <u>2,810</u>	~124	<b>1,169</b> <u>2,631</u>		161	450	

**TS-17 Construction Descriptions**

Construction will begin at began at the hunting cabin turn off, 300 ft from the pad site.

Topsoil will be was removed form the project cut areas (Table 5K-2) and placed in the WHR

Tank Seam Topsoil Stockpile located inside the bend of the corner east of the pad. Material will

then be was then removed from the road cuts and compacted around the outside of the two

switchbacks located inside the area in order to allow them it to be widened. As the cut

progresses up the road into the pad, topsoil will be was removed prior to the road cut being made

and placed in the storage pile. Cuts will be were made starting at the lower end of the access

road and proceed up to and through the Tank Seam Portal Pad east end of the pad and moving

towards the west. Most of the material will be hauled approximately 300 200 ft. and placed at

the turn intersected by the hunting cabin road. The rest of the material will be hauled no more

than 700 ft. to the turn above the Blind Canyon Seam Pad. A retaining wall (shown on plate 5-

2G) will be built bellow the turn intersected by the hunting cabin road in order to maintain the

maximum allowed slope on the soil below the turn. Cross-sections are shown in attachment A.

Table 5K-2  
**TS-17 Summary of Cut and Fill Volumes**

Area	Cut Vo. (Cu Yds.)	Topsoil (Cu Yds.)	Fill Vol. (Cu Yds.)	Excess (Cu Yds.)	Amount Hauled	Avg Haul Dist. (Ft)	Cum. Vol. (Cu Yds.)
0+00	<u>138 0</u>	<u>-138 0</u>	<u>1,357 2,445</u>	<u>1,219 2,445</u> fill	<u>1,219 2,445</u>	<u>700 300</u>	<u>-1,219 2,445</u>
0+50	<u>80 0</u>	<u>-80 0</u>	<u>1,430 3,038</u>	<u>1,350 3,038</u> fill	<u>1,350 3,038</u>	<u>700 300</u>	<u>-2,569 5,483</u>
1+00	<u>279 30</u>	<u>-101 0</u>	<u>624 2,179</u>	<u>345 2,149</u> fill	<u>532 2,149</u>	<u>50 300</u>	<u>-2,914 7,632</u>
1+50	<u>686 50</u>	<u>-107 0</u>	<u>144 2,056</u>	<u>543 cut 2,006</u> fill	<u>-0 2,006</u>	<u>-0 300</u>	<u>-2,371 9,638</u>
2+00	<u>2,033 1,909</u>	<u>-135 0</u>	<u>121, 1,046</u>	<u>1,912 cut 863</u> cut	<u>-0-</u>	<u>-0-</u>	<u>-459 8,775</u>
2+50	<u>4,648 5,447</u>	<u>-326 0</u>	<u>841, 1,446</u>	<u>3,807 4,001</u> cut	<u>3,807 -0-</u>	<u>300 -0-</u>	<u>3,348 4,774</u>
3+00	<u>2,852 3,791</u>	<u>-281 0</u>	<u>3,876 1,844</u>	<u>1,024 fill 1,948</u> cut	<u>1,024 -0-</u>	<u>300 -0-</u>	<u>2,324 2,826</u>
3+50	<u>313 2,375</u>	<u>-149 0</u>	<u>2,696 676</u>	<u>2,383 fill 1,699</u> cut	<u>2,141 -0-</u>	<u>300 -0-</u>	<u>-59 1,124</u>
4+00	<u>1,453</u>	<u>0</u>	<u>240</u>	<u>1,213</u> cut	<u>0</u>	<u>0</u>	<u>86</u>
<b>Totals</b>	<u>11,029</u> <u>15,055</u>	<u>-1,317</u> <u>1,760</u>	<u>11,089 14,969</u>		<u>10,173 9,638</u>	<u>388 300</u>	

Topsoil depths vary from 6-10 inches along the access road and are 8 inches at the pad site, but may be as deep as 20 inches along the northeast edge of the pad (Appendix 2-G). Assuming a topsoil depth of 8 inches approximately 1,400 cu. yds. of topsoil will be recovered from the construction area. The topsoil stockpile can hold a maximum of 1,800 holds 1,760 cu yds. of material. 0.71 acres need to be reclaimed. This will allow us to go deeper than the 8 inches in any areas that are required and still store the material depending on the actual depth of topsoil encountered during construction. If the amount of topsoil material recovered from areas TS-16 and TS-17 exceed the capacity of the topsoil stockpile the additional material will be hauled to the WHR topsoil stockpile. If both the capacity of both the WHR topsoil stockpile and the WHR Tank Seam topsoil stockpile are exceeded the material will be placed in the area labeled Potential Additional Topsoil Storage shown on plates 5-2 and 2-3G.

Silt fences will be placed below the disturbed area before both construction and reclamation begin. During the initial road cut, care ~~will be~~ was taken to prevent disturbed material from migrating downslope in the following manner. The initial removal ~~will be~~ was made using a backhoe. Trees and/or shrubs immediately ahead of the cut ~~will be~~ was removed by pulling them back into the previous cut. Using the backhoe, a berm ~~will be~~ was created on the downhill side of the cut, as shown in Figure 5G-1. When the berm ~~is in~~ was in place, the road cuts ~~will be~~ was started as shown in Figure 5G-1 and 5G-2 using a backhoe and/or front end loader. The road cuts ~~will be~~ was made into the slope towards the cut face rather than parallel to the slope, which ~~will result~~ resulted in any rocks or sloughage dislodged by the equipment during the road cutting to be contained within the berm. In the event blasting is required, which is described in Appendix 5 E, the blasts ~~will be designed to drop the material into the cut area behind the berm. This will prevent material generated by the blast from migrating into the undisturbed area.~~

Cut slopes, fill slopes, and fill placement will follow the recommendations given in the Slope Stability analysis and report, included in Attachment B. Large boulders will also be placed according to the report. Where possible, care will be taken to avoid disturbing large trees of commercial value and any canyon sweetvetch plants located in the area (see chapter 3). Exposed slopes will be covered with erosion control matting as described in Appendix 7-K.

This procedure ~~will be~~ was followed for the construction of the Tank Seam portal pad as well. A road ~~will be~~ was cut across the entire length of the pad and a berm established. The backhoe ~~will~~ was then turned into the mountain and start widening the pad, first recovering the topsoil.

Final crowning of the road, laying of road base and installation of permanent ditches will be was completed following the initial road contouring. The approximate road contours are shown on Plate 5-2G.

During reclamation, the cut and fill process described above will be reserved reversed. The reclaimed slopes will be reconstructed to approximate original contour. Subsoil material will be compacted in a minimum of 12 inch lifts. A minimum 8" of topsoil will be placed uncompacted over the regraded area. Topsoil material will be pocked to aid in water retention and runoff control during vegetation establishment (See Appendix 7-K). The 1,000 cu. yds. used in TS-15 and any material used in TS-7 and TS-8 will be replaced by material from TS-5 during reclamation. All material moved will be sampled for toxicity according to table 5O-1

Most areas of the road will remain in place for post-mining access to a hunting cabin. These areas are shown on Plate 2-3G and are labeled "area not requiring recontouring or topsoil within the disturbed boundary". The remaining areas of the road will be completely removed and used for fill material during the cut and fill process and the pre-mining road will be restored as shown on the cross-sections in Attachment A. A more detailed description of the hunting cabin can be found on page 4-4 of the MRP. No culverts will be removed since they are needed for access to the hunting cabin.

During construction 1,000 cu. yds. Of material was hauled to TS-15 as described on page 5J-13. Any additional material generated due to miner variations will be hauled to TS-7 and TS-8 for reclamation in those areas.

## **Attachment A**

### **Cut and Fill Calculations**

~~The cut and fill volumes shown in Table 5k-1 and 5k-2 represent the maximum volumes that will be encountered. Final contours and pad dimensions may vary somewhat to account for any variation in cut and fill volumes. As built contours and cut and fill volumes will be submitted to the Division following construction.~~

Volume measurements were made using "Quicksurf" 3D modeling software with AutoCad. They are based on the contours shown on Plate 5-7G for pre-mining configuration, Plate 5-2G for operational configuration, and Plate 5-6G for post-mining configuration. Cross-sections for each configurations are shown on the following pages. The locations of the cross-sections are shown on Plates 5-6G and 2-3G.

Table 7-23 Summary of Storm Runoff Calculations for 10 Year 6 Hour Storm (cont)

Watershed	Curve Number CN	Time of Concentration (Hr)	Drainage Area (Acres)	Peak Discharge (CFS)
AU-20	76	0.131 <u>0.119</u>	20.55 <u>12.38</u>	2.37 <u>1.48</u>
AU-21	76	0.110 <u>0.130</u>	9.45 <u>9.57</u>	1.15 <u>1.11</u>
AU-22	76	0.086 <u>0.090</u>	12.12 <u>12.13</u>	1.59 <u>1.57</u>
AU-23	76	0.093 <u>0.099</u>	5.25 <u>5.56</u>	0.64 <u>0.91</u>
AU-23A	76	0.033	0.28	0.04
AU-24	76	0.119	13.89	1.66
AU-25	76	0.087	2.27	0.30
AU-26	76	0.033 <u>0.1077</u>	0.63 <u>8.72</u>	0.10 <u>1.08</u>
AU-27	76	0.027	0.2	0.03
AU-28	76	0.039 <u>0.30</u>	0.59 <u>0.70</u>	0.09 <u>0.11</u>
AU-28A	76 <u>90</u>	0.071 <u>0.025</u>	0.99 <u>0.17</u>	0.14 <u>0.12</u>
AU-29	76	0.025 <u>0.21</u>	1.29 <u>1.23</u>	0.29 <u>0.20</u>
AU-29A	76	0.023 <u>0.020</u>	0.55 <u>0.46</u>	0.67 <u>0.05</u>
AU-30	76	0.029	0.49	0.08
AU-31	76	0.048	2.21	0.32
AU-32	76	0.036	1.84	0.28
AU-33	76	0.040	0.71	0.11
AU-34	76	0.045	1.84	0.27
AU-35	76	0.032	0.2	0.13
AU-36	76	0.031	0.75	0.12
AU-37	76	0.198	139.82	13.64
AU-38	76	0.094	8.97	1.15
AU-39	76	0.048	1.26	0.18
AU-40	76	0.283	197.5	15.96
AU-41	76	0.100	11.59	1.46
AU-42	76	0.002	4.24	0.67
AU-43	76	0.095	13.7	1.75

Table 7-23 Summary of Storm Runoff Calculations for 10 Year 6 Hour Storm (cont)

Watershed	Curve Number CN	Time of Concentration (Hr)	Drainage Area (Acres)	Peak Discharge (CFS)
AD-1A	76	0.090	3.70	0.48
AD-1B	76	0.037	2.12	0.32
AD-2A	76	0.040	0.97	0.15
AD-2B	83	0.025	1.08	0.41
AD-2C	83	0.012	0.25	0.10
AD-3A	76	0.034	1.49	0.23
AD-3B	76	0.034	0.78	0.12
AD-4	83	0.011	0.08	0.03
AD-5	76	0.056	2.13	0.30
AD-6	90	0.220	1.39	0.81
AD-7	90	0.145	2.95	1.83
AD-8 upper	90	0.021	0.70	0.48
AD-8 lower	90	0.247	2.79	1.59
AD-9	90	0.069	0.35	0.23
AD-10 upper	90	0.026	0.30	0.20
AD-10 lower	90	0.078	0.65	0.42
AD-11	95	0.011	0.69	0.65
AD-12 upper	90	0.020	0.22	0.15
AD-12 lower	90	0.076	0.34	0.22
AD-13	91	0.106	1.78	1.23
AD-14	90	0.009	0.08	0.05
AD-15	90	0.069	1.83	1.20
AD-16	90	0.030	0.77	1.24
AD-17	90	0.019	0.24	0.16
AD-18	90	0.170	0.9	0.55
AD-19	90	0.009	0.15	0.10
AD-20	90	0.019 <u>0.0102</u>	0.47 <u>0.65</u>	0.32 <u>0.44</u>
AD-21	90	0.0061	0.23	0.16

<sup>1</sup> Sized for the 100 Yr – 6 hr storm event.

Table 7-24      Summary of Division Ditch Calculations

Ditch	Bottom Width (Ft)	Top Width (Ft)	Depth (Ft)	Type Side Slope H:V	Measured Slope %	Contributing Watershed	REQ'D Av. Rip-Rap Size (In.)
D-1D	0	1.33	0.67	1:1	2 Min 11 Max	AD-3A	Soil
D-2D	0	1.33	0.67	1:1	6 Min 20 Max	AD-3A, AD-5	Bedrock
D-3D	0	2	1	1:1	2 Min 6 Av. 18 Max	AD-3A, AD-5, AD-7	Soil Soil Grouted
D-4D	0	2	1	1:1	2 Min 6 Av. 17 Max	AD-14	Soil Soil $D_{50}$ 6"
D-5D	0	1.33	0.67	1:1	4 Min 10 Max	AD-9	Soil
D-6D	0	3	1.5	1:1	2 Min 4 Max	AD-3A, AD-5 AD-7, AD-9, AD-10 AD-12, AD-14	Soil
D-7D	2	3.5	0.75	1.5:1	2 Min 6 Av. 55 Max	AD-1A, AD-1B, AD-2A AD-2B, AD-2C, AD-3B AD-4, AD-6, AD-8	Soil Soil $D_{50}$ 6"
D-8D	0	2	1	1:1	2 Min 7 Max	AD-13	Soil
D-8D Water Bar	0	14	0.33	6:1	3 Av.	AD-13	Soil
D-9D	0	2	1	1:1	4 Min 10	AD-15	Soil
D-10D	1	3.33	0.67	1.5:1	7 Min 50	AD-6, AD-3B, (part) AD-2B, AD-2C	$D_{50}$ 4" Bedrock
D-11D	0	1	0.5	1:1	41 Min Near Vert.	Tipple Wash Hose	Grouted Rip-Rap
D-12D	0	1	0.5	1:1	81 Av.	Tipple Wash Hose	Soil
D-13D Water Shed	0	6	0.5	10:1 2:1	0.5 Av.	AD-6 Partial	Soil
D-14D	0	1.33	0.67	1.5:1	0.06 Av.	AU-4A	Soil
D-15D	0	2.00	1.00	1:1	0.05 Av.	AD-16	Soil
D-16D	0	1.50	1.75	1:1	0.05 Av.	AD-18	Soil
D-17D	0	.96	4	1:1	0.08 Av.	AU-23, AD-20	Soil

- Notes:
- Dimensions given indicate minimum requirements. Actual dimensions may vary. Minimum required cross-sections will be maintained.
  - The use of line drainage ditches is required when flow velocities exceed approximately 5 feet per second. Rip-rap may be installed where not required.

Table 7-24 Summary of Division Ditch Calculations (Cont)

Ditch	Bottom Width (Ft)	Top Width (Ft)	Depth (Ft)	Type Side Slope H:V	Measured Slope %	Contributing Watershed	REQ'D Av. Rip-Rap Size (In.)
D-17U	0	2	0.67	1.5:1	13 Av.	AU-1 <sup>a</sup>	Bedrock
D-18U	0	2	0.67	1.5:1	5 Min	AU-1	Soil
D-19U	0	2	0.67	1.5:1	6 Av.	AU-2B	Soil
D-20U	0	1.33	0.67	1:1	16 Av.	AU-42	Soil
D-21U	0	2	1.0	1:1	13 Av.	AU-43	$D_{50}=3''$
D-22U	0	3	1.0	1.5:1	11 Av.	AU-19, AU-25	$D_{50}=6''$
D-23U	0	1.16	0.58	1:1	19 Av.	AU-36	Soil
D-24U	0	1.16 2.00	0.58 1.0	1:1	14 Av.	AU-35, C-28U	Soil
D-25U	0	1	0.5	1:1	16 Av.	AD-17	Soil
D-26U	0	1	0.5	1:1	24 Av.	AU-32	Soil
D-27U	0.50	2 0.9	0.5 0.3	1.5:1	13 Min, 30 Max	AU-31, C-31U	Soil, Bedrock
D-28U	0	1	0.5	1:1	14 Av.	AU-33	Soil
D-29U	0	1.33	0.67	1:1	8 Av.	AU-34	Soil
D-30U	0	1.16	0.58	1:1	13 Av.	AU-25	Soil
D-31U	0	3	1.0	1.5:1	12 Av.	AU-20, AU-26, AU-30, C37U	Bedrock
D-32U	0	1	0.5	1:1	17 Av.	AU-30	Soil
D-33U	0	1.16 1.0	0.58 0.50	1:1	18 Av.	AU-27, AU-28, AU-29, AU-29A	Soil
D-34U	1	2.74	0.58	1.5:1	11 Av.	AU-24, AU-23, AU-28A	Soil
D-35U	0	2.0 1.125	1.0 0.75	1:1 1.5:1	10 Av.	AU-29, AU-27	Soil
D-36U	0	1.0	0.5	1:1	8 Av.	AU-27	Soil
D-37U	0	1.0 1.5	0.5 1.0	1:1 1.5:1	8 Av.	AU-26, AU-21, AU-22	Soil
D-38U	0	1.33 1.5	0.67 1.0	1:1 1.5:1	12 Min, 20 Max	AU-21, AU-22	$D_{50}=3''$
D-39U	0	1.0 0.75	0.5	1:1 1.5:1	10 Av.	AU-28	Soil

Table 7-24 Summary of Division Ditch Calculations (Cont)

Ditch	Bottom Width (Ft)	Top Width (Ft)	Depth (Ft)	Type Side Slope H:V	Measured Slope %	Contributing Watershed	REQ'D Av. Rip-Rap Size (In.)
D-40U	0	1.5 <u>0.75</u>	0.75 <u>0.50</u>	1:1 <u>1.5:1</u>	9 Av.	AU-24A, C 39U AU-28A	D <sub>50</sub> =3
D-41U	0	2	1	1:1	15 Av.	AU-22, AU-23A, C 40U	D <sub>50</sub> =4
D-42U	0 <u>2.0</u>	0.5 <u>2.5</u>	0.25 <u>1.25</u>	1:1 <u>1:1</u>	36 Min, 63Max	AU-23A <u>AU-22</u>	Soil, D <sub>50</sub> =3
D-43U	0 <u>2.0</u>	2	2 <u>2.25</u>	2:1 <u>1:2</u>	20 Min, 45 Max	AU-23	D <sub>50</sub> =5 Soil

- Notes:
1. Dimensions given indicate minimum requirements. Actual dimensions may vary. Minimum required cross-sections will be maintained.
  2. The use of riprap to line drainage ditches is required when flow velocities exceed approximately 5 feet per second. Riprap may be installed where not required.

Table 7-25 Culvert Characteristics

Culvert	Diameter (in.)	Type	Contributing Watersheds	Slope (ft/ft)	Outlet Condition
C-21U	36	CMP	Right Fork Drainage	0.06	Bedrock
C-22U	20	CMP	AU-19, AU-25	0.06	Soil
C-23U	36	CMP	AU-36, AU-35, AU-34, AU-20, AU-26, C-24U <u>C-28U</u>	0.06	11" rip-rap
C-24U	32	CMP	AU-40, <u>C-25U, C-26U</u>	0.06	10" rip-rap
C-25U	30	CMP	<u>AD-17, C-26U</u>	0.06	8" rip-rap
C-26U	30	CMP	AU-39, AU-32, AU-33, <u>C-30U, C-34U</u>	0.06	8" rip-rap
C-27U	15	CMP	AU-22, AU-28, AU-29A, AU-31, <u>C-31U</u>	0.06	4" rip-rap
C-28U	15	CMP	<u>AU-43, C-29U, AU-34</u>	0.06	4" rip-rap
C-29U	15	CMP	AU-20, <u>AU-21, AU-22</u> <u>AU-25, AU-26, AU-30</u>	0.06	3" rip-rap
C-30U	15	CMP	<u>AU-21, AU-27, AU-30</u> Abandoned In Place	0.06	Soil
C-31U	12	CMP	<u>AU-27, AU-29, AU-</u> <u>29A, C-38U</u>	0.06	Soil
C-32U	15	CMP	<u>AU-22, AU-28, AU-29A</u>	0.06	3" rip-rap
C-33U	24	CMP	AU-24, AU-28A, AU-37 <u>.AU-23</u>	0.06	8" rip-rap
C-34U	24	CMP	<u>AD-19, AU-31, AU-37,</u> <u>AU-38, C-31U, C-32U</u> <u>AU-38, C-27U, C-33U</u>	0.06	8" rip-rap
C-35U	84	CMP	Bear Creek	0.06	48" rip-rap
C-36U	15	CMP	<u>AU-27, AU-21</u> Abandoned In Place	0.11	3" rip-rap
C-37U	15	CMP	Abandoned In Place		
C-38U	15	CMP	AU-28	0.08	Soil
C-39U	15 <u>12</u>	CMP	AU-22,	0.18 <u>0.06</u>	6" rip-rap <u>Soil</u>
C-40U	12	CMP	AU-23	0.001	Soil

Table 7-25 Culvert Characteristics (Cont)

Culvert	Diameter (in.)	Type	Contributing Watersheds	Slope (ft/ft)	Outlet Condition
C-1D	15	CMP flexible	AD-6, AD-3B	1.00	24" rip-rap
C-2D	15	CMP, RCP flexible	AD-2B, AD-2C, AD- 3B, AD-4, AD-6	4.0	10" rip-rap
C-3D	20	slt pipe	AD-3A	0.03	4" rip-rap
C-4D	21	CMP	AD-3A, AD-5, AD-7, AD-14, C-10D	0.18	9" rip-rap
C-5D	18	CMP	AD-9	0.08	Soil
C-6D	12	CMP	AD-10	0.48	9" rip-rap
C-7D	18	CMP	Abandoned In Place		
C-8D	18	CMP	AD-3A, AD-5, AD-7	0.05	3" rip-rap
C-9D	18	CMP	See C-8D	0.05	3" rip-rap
C-10D	18	CMP	Tipple Wash Hose	0.03	Soil
C-11D	12	CMP flexible	AD-4A	0.05 0.25	3" rip-rap
C-12D	8	CMP	AD-18	0.05	Soil
C-13D	12	CMP	AU-23, AD-20	0.07	Soil

# **APPENDIX 7-G**

## **DIVERSION ADEQUACY CALCULATIONS**

### WATERSHED CHARACTERISTICS

Disturbed Areas

P = 1.5"

<u>Watershed</u>	<u>CN</u>	<u>Area (Ac.)</u>	<u>Slope y (%)</u>	<u>Hyd length 1 (ft.)</u>	<u>1000 S=-10 CN</u>	<u><math>\frac{1.8(s+1)}{L=1900Y^5}</math></u>	<u>T=1.67L</u>	<u>Time of Conc (hr)</u>
AD-1A	76	3.70	66	1,300	3.16	0.050		0.090
AD-1B	76	2.12	95.5	520	3.16	0.022		0.037
AD-2A	76	0.97	72	440	3.16	0.020		0.040
AD-2B	83	1.08	59	320	2.05	0.015		0.025
AD-2C	83	0.25	64	140	2.05	0.007		0.012
AD-3A	76	1.49	70	400	3.16	0.021		0.034
AD-3B	76	0.78	71	400	3.16	0.020		0.034
AD-4	83	0.08	49	100	2.05	0.007		0.011
AD-5	76	2.13	73	760	3.16	0.034		0.056
AD-6	90	1.39	1.7	720	1.11	0.131		0.220
AD-7	90	2.95	8.0	1,130	1.11	0.087		0.145
AD-8 upper	90	0.70	70	400	1.11	0.013		0.021
AD-8 lower	90	2.79	1.0	600	1.11	0.148		0.247
AD-9	90	0.35	7.2	420	1.11	0.042		0.069
AD-10 upper	90	0.30	34	320	1.11	0.015		0.026
AD-10 lower	90	0.65	2.0	220	1.11	0.047		0.078
AD-11	95	0.69	20	110	0.53	0.007		0.011
AD-12 upper	90	0.22	64	340	1.11	0.012		0.020
AD-12 lower	90	0.34	8.0	500	1.11	0.045		0.076
AD-13	91	1.78	8.0	800	0.99	0.063		0.106
AD-14	90	0.08	61	120	1.11	0.005		0.009
AD-15	90	1.83	10.5	530	1.11	0.041		0.069
AD-16*	90	0.77	22	303	1.11	0.018		0.030
AD-17*	90	0.24	27	190	1.11	0.011		0.019
AD-18	90	0.9	3.2	771	1.11	0.102		0.170
AD-19*	90	0.15	49.24	109	1.11	0.005		0.009
AD-20*	90	0.47 <u>0.65</u>	30.48	204	1.11	<u>0.0113</u>	<u>0.0119</u>	
			<u>48.76</u>	<u>126</u>		<u>0.006</u>	<u>0.010</u>	
<u>AD-21</u>	<u>90</u>	<u>0.23</u>	<u>47.08</u>	<u>65</u>	<u>1.11</u>	<u>0.004</u>	<u>0.006</u>	

\*Areas AD-16, AD-17 and AD-19 are ASCA areas treated by alternate sediment controls.

**WATERSHED CHARACTERISTICS**  
 Undisturbed Areas  
 and ASCA Areas Not Reporting To Sediment Pond

<u>Watershed</u>	<u>CN</u>	<u>Area (Ac.)</u>	Slope y (%)	Hyd length 1 (ft.)	<u>1000</u> <u>S=-10 CN</u>	<u><math>\frac{1^8(s+1)^7}{L=1900Y^5}</math></u>	P = 1.5" T=1.67L Time of Conc (hr)
AU-1	76	6.46	57	1,240	3.16	0.056	0.094
AU-1A	83	1.36	65	460	2.05	0.019	0.032
AU-1B	83	1.16	59	330	2.05	0.015	0.026
AU-1C	76	16.40	72	1,950	3.16	0.072	0.120
AU-2	76	2.23	62	975	3.16	0.045	0.075
AU-2A	76	1.64	63	1,025	3.16	0.046	0.077
AU-2B	76	3.80	63	1,100	3.16	0.049	0.081
AU-3	76	3.87	65	1,060	3.16	0.047	0.078
AU-3A	76	0.30	64	140	3.16	0.009	0.016
AU-4	76	7.97	63	1,300	3.16	0.056	0.093
AU-4A	83	0.92	52	357	2.05	0.018	0.029
AU-5	76	20.14	77.3	1,700	3.16	0.062	0.104
AU-6	76	2.73	70.0	780	3.16	0.035	0.059
AU-7	76	13.46	69.4	1,400	3.16	0.056	0.094
AU-8	76	4.95	85.7	720	3.16	0.030	0.050
AU-9	76	4.77	64.8	1,440	3.16	0.060	0.100
AU-10	76	35.52	76.1	2,380	3.16	0.082	0.137
AU-11	76	0.62	73.0	570	3.16	0.027	0.045
AU-12	76	2.33	44.1	480	3.16	0.030	0.050
AU-13	76	0.66	77.5	240	3.16	0.013	0.022
AU-14	76	2.43	66.7	620	3.16	0.030	0.050
AU-15	76	0.91	15.6	300	3.16	0.035	0.058
AU-16	76	44.93	71.0	2,580	3.16	0.091	0.152
AU-17	76	30.10	71.0	2,580	3.16	0.091	0.152
AU-18	76	36.55	71.0	2,580	3.16	0.091	0.152
AU-19	76	36.03	60.5	2,190	3.16	0.086	0.144
AU-20	76	20.55 <u>12.38</u>	57.6	1,880	3.16	0.078 <u>0.071</u>	0.131 <u>0.119</u>
			<u>51.5</u>	<u>1,563</u>			
AU-21	76	9.45 <u>9.57</u>	48.4	1,360	3.16	0.066 <u>0.078</u>	0.110 <u>0.130</u>
			<u>43.0</u>	<u>1,556</u>			
AU-22	76	12.05 <u>12.13</u>	60.3	1,120	3.16	0.051 <u>0.054</u>	0.084 <u>0.090</u>
			<u>52.93</u>	<u>1,112</u>			

### WATERSHED CHARACTERISTICS (Con't)

Undisturbed Areas  
and ASCA Areas Not Reporting To Sediment Pond

$P = 1.5"$

<u>Watershed</u>	<u>CN</u>	<u>Area (Ac.)</u>	<u>Slope y (%)</u>	<u>Hyd length l (ft.)</u>	<u><math>S=-10</math></u>	<u><math>\frac{1000}{CN}</math></u>	<u><math>\frac{l^8(s+1)^7}{1900Y^5}</math></u>	<u>T=1.67L</u>
AU-23	76	6.59 <u>5.56</u>	46. <u>52.7</u>	1,500 <u>1,268</u>	3.16	0.073	<u>0.060</u>	0.122 <u>0.100</u>
AU-24	76	13.92	59.3	1,710	3.16	0.072		0.119
AU-25	76	2.27	46.1	980	3.16	0.052		0.087
AU-26	76	0.63 <u>8.72</u>	50.6 <u>50.2</u>	310 <u>1,354</u>	3.16	0.020	<u>0.064</u>	0.033 <u>0.108</u>
AU-27	76	0.2	33.6	190	3.16	0.016		0.027
AU-28	76	0.64 <u>0.70</u>	49.3 <u>57.6</u>	310 <u>300</u>	3.16	0.020	<u>0.018</u>	0.033 <u>0.030</u>
<u>AU-28A</u>	<u>76</u>	<u>0.17</u>	<u>31.49</u>	<u>300</u>	<u>1.11</u>		<u>0.015</u>	<u>0.025</u>
AU-29	76	1.29 <u>1.23</u>	40.1 <u>41.1</u>	190 <u>160</u>	3.16	0.015	<u>0.013</u>	0.025 <u>0.022</u>
AU-29A	76	0.55 <u>0.46</u>	53.4 <u>55.76</u>	200 <u>176</u>	3.16	0.014	<u>0.012</u>	0.023 <u>0.020</u>
AU-30	76	0.49	49.5	265	3.16	0.018		0.029
AU-31	76	2.21	63.6	570	3.16	0.029		0.048
AU-32	76	1.84	81.2	460	3.16	0.021		0.036
AU-33	76	0.71	64.3	460	3.16	0.024		0.040
AU-34	76	1.84	71.0	560	3.16	0.027		0.045
AU-35	76	0.2	56.6	320	3.16	0.019		0.032
AU-36	76	0.75	56.3	310	3.16	0.019		0.031
AU-37	76	139.82	60.3	3,250	3.16	0.119		0.198
AU-38	76	8.97	75.3	1,480	3.16	0.057		0.094
AU-39	76	1.26	75.1	630	3.16	0.029		0.048
AU-40	76	197.5	62.8	5,210	3.16	0.169		0.283
AU-41	76	11.59	62.3	1,420	3.16	0.060		0.100
AU-42	76	4.24	46.1	10	3.16	0.001		0.002
AU-43	76	13.7	71.2	1,440	3.16	0.057		0.095
Bear Creek	76	1,728	58.1	12,800	3.16	0.362		0.604

Summary of Peak Flows for 10-year, 6-hour storm P=1.5"  
 (SCS type B distribution)

<u>Watershed</u>	<u>Peak Q (cfs.)</u>	<u>Watershed</u>	<u>Peak Q (cfs)</u>	<u>Watershed</u>	<u>Peak Q (cfs)</u>
AD-1A	0.48	AU-1B	0.44	AU-23	<u>0.78</u> <u>0.91</u>
AD-1B	0.32	AU-1B	0.44	AU-24	1.66
AD-2A	0.15	AU-1C	1.95	AU-25	0.30
AD-2B	0.41	AU-2	0.30	AU-26	<u>0.10</u> <u>1.08</u>
AD-2C	0.10	AU-2A	0.22	AU-27	0.03
AD-3A	0.23	AU-2B	0.50	AU-28	<u>0.10</u> <u>0.11</u>
AD-3B	0.12	AU-3	0.52	<u>AU-28a</u>	<u>0.12</u>
AD-4	0.03	AU-3A	0.05	AU-29	<u>0.29</u> <u>0.20</u>
AD-5	0.30	AU-4	1.02	AU-29A	<u>0.67</u> <u>0.05</u>
AD-6	0.81	AU-4A	0.35	AU-30	0.08
AD-7	1.83	AU-5	2.51	AU-31	0.32
AD-8 upper	0.48	AU-6	0.39	AU-32	0.28
AD-8 lower	1.59	AU-7	1.72	AU-33	0.11
AD-9	0.23	AU-8	0.72	AU-34	0.27
AD-10 upper	0.20	AU-9	0.60	AU-35	0.13
AD-10 lower	0.42	AU-10	4.05	AU-36	0.12
AD-11	0.65	AU-11	0.09	AU-37	13.64
AD-12 upper	0.15	AU-12	0.34	AU-38	1.15
AD-12 lower	0.22	AU-13	0.10	AU-39	0.18
AD-13	1.23	AU-14	0.35	AU-40	15.96
AD-14	0.05	AU-15	0.13	AU-41	1.46
AD-15	1.20	AU-16	4.92	AU-42	0.67
AD-16	1.24	AU-17	3.29	AU-43	1.75
AD-17	0.16	AU-18	4.00	BEAR CREEK	108.18
AD-18	0.55	AU-19	4.03	BEAR CREEK <sup>1</sup>	412.70
AD-19	0.10	AU-20	<u>2.37</u> <u>1.48</u>		
AD-20	0.44	AU-21	<u>1.15</u> <u>1.11</u>		
AD-21	0.16	AU-22	<u>1.59</u> <u>1.57</u>		
AU-1	0.83				
AU-1A	0.51				

<sup>1</sup>Design flow for the 100 year, 6 hour storm event.

**PEAK**  
**HYDROGRAPH GENERATION PROGRAM**

**INPUT SUMMARY FOR W.S.: AD-20**

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 90 Time of Conc. = 0.019 <u>0.0102</u> hr Area = 0.47 <u>0.65</u> ac

**OUTPUT SUMMARY**

Runoff depth = 0.6835 in
Initial Abstraction = 0.2222 in
Peak Flow = 0.32 <u>0.44</u> cfs      ( <u>0.6743</u> <u>0.6788</u> iph)
At T = 2.50 hrs

**INPUT SUMMARY FOR W.S.: AD-21**

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 90 Time of Conc. = 0.0061 hr Area = 0.23 ac

**OUTPUT SUMMARY**

Runoff depth = 0.0000 in
Initial Abstraction = 0.2222 in
Peak Flow = 0.16 cfs (0.6803 iph)
At T = 2.50 hrs

**PEAK**  
**HYDROGRAPH GENERATION PROGRAM**

INPUT SUMMARY FOR W.S.: AU-20

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.131 <u>0.1193</u> hr Area = 20.55 <u>12.38</u> ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in  
Initial Abstraction = 0.6316 in  
Peak Flow = 2.37 1.48 cfs    (0.1146 0.1185 iph)  
At T = 2.55 hrs

INPUT SUMMARY FOR W.S.: AU-21

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.110 <u>0.1301</u> hr Area = 9.45 <u>9.57</u> ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in  
Initial Abstraction = 0.6316 in  
Peak Flow = 4.15 1.11 cfs    (0.1212 0.1149 iph)  
At T = 2.54 2.55 hrs

**PEAK**  
**HYDROGRAPH GENERATION PROGRAM**

**INPUT SUMMARY FOR W.S.: AU-22**

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.084 <u>0.0896</u> hr Area = <u>12.05</u> <u>12.13</u> ac

**OUTPUT SUMMARY**

---

Runoff depth = 0.1873 in  
Initial Abstraction = 0.6316 in  
Peak Flow = 4.59 1.57cfs      (0.1305 0.1286 iph)  
At T = 2.53 hrs

---

**INPUT SUMMARY FOR W.S.: AU-23**

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.122 <u>0.0997</u> hr Area = <u>6.59</u> <u>5.56</u> ac

**OUTPUT SUMMARY**

---

Runoff depth = 0.1873 in  
Initial Abstraction = 0.6316 in  
Peak Flow = 0.78 0.91cfs      (0.1213 0.1629 iph)  
At T = 2.55 2.50 hrs

---

**PEAK**  
**HYDROGRAPH GENERATION PROGRAM**  
**INPUT SUMMARY FOR W.S.: AU-23A**

---

STORM:	WATERSHED:
Distribution = SCS Type 'B'	Curve Number = 76
Precip. Depth = 1.50 in	Time of Conc. = 0.033 hr
Duration = 6.00 hr	Area = 0.28 ac

---

**OUTPUT SUMMARY**

---

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.04 cfs (0.1513 iph)
At T = 2.51 hrs

---

**INPUT SUMMARY FOR W.S.: AU-24**

---

STORM:	WATERSHED:
Distribution = SCS Type 'B'	Curve Number = 76
Precip. Depth = 1.50 in	Time of Conc. = 0.119 hr
Duration = 6.00 hr	Area = 13.92 ac

---

**OUTPUT SUMMARY**

---

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 1.66 cfs (0.1182 iph)
At T = 2.55 hrs

---

**PEAK**  
**HYDROGRAPH GENERATION PROGRAM**

**INPUT SUMMARY FOR W.S.: AU-25**

**STORM:**

Distribution = SCS Type 'B'  
Precip. Depth = 1.50 in  
Duration = 6.00 hr

**WATERSHED:**

Curve Number = 76  
Time of Conc. = 0.087 hr  
Area = 2.27 ac

**OUTPUT SUMMARY**

Runoff depth = 0.1873 in  
Initial Abstraction = 0.6316 in  
Peak Flow = 0.30 cfs (0.1296 iph)  
At T = 2.53 hrs

**INPUT SUMMARY FOR W.S.: AU-26**

**STORM:**

Distribution = SCS Type 'B'  
Precip. Depth = 1.50 in  
Duration = 6.00 hr

**WATERSHED:**

Curve Number = 76  
Time of Conc. = 0.033 0.1077 hr  
Area = 0.63 8.72 ac

**OUTPUT SUMMARY**

Runoff depth = 0.1873 in  
Initial Abstraction = 0.6316 in  
Peak Flow = 0.10 1.08 cfs (0.1516 0.1225 iph)  
At T = 2.50 2.54 hrs

**PEAK**  
**HYDROGRAPH GENERATION PROGRAM**

**INPUT SUMMARY FOR W.S.: AU-27**

---

**STORM:**

Distribution = SCS Type 'B'  
Precip. Depth = 1.50 in  
Duration = 6.00 hr

**WATERSHED:**

---

Curve Number = 76  
Time of Conc. = 0.027 hr  
Area = 0.20 ac

---

**OUTPUT SUMMARY**

---

Runoff depth = 0.1873 in  
Initial Abstraction = 0.6316 in  
Peak Flow = 0.03 cfs (0.1541 iph)  
At T = 2.51 hrs

---

**INPUT SUMMARY FOR W.S.: AU-28**

---

**STORM:**

Distribution = SCS Type 'B'  
Precip. Depth = 1.50 in  
Duration = 6.00 hr

**WATERSHED:**

---

Curve Number = 76  
Time of Conc. = 0.033 0.030 hr  
Area = 0.64 0.70 ac

---

**OUTPUT SUMMARY**

---

Runoff depth = 0.1873 in  
Initial Abstraction = 0.6316 in  
Peak Flow = 0.10 0.11 cfs (0.1516 iph)  
At T = 2.50 hrs

---

**PEAK**  
**HYDROGRAPH GENERATION PROGRAM**  
**INPUT SUMMARY FOR W.S.: AU-28A**

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 <u>90</u> Time of Conc. = 0.074 <u>0.025</u> hr Area = 0.99 <u>0.17</u> ac

**OUTPUT SUMMARY**

Runoff depth = 0.1873 0.6835 in  
Initial Abstraction = 0.6316 0.2222 in  
Peak Flow = 0.14 0.12 cfs    (0.1359 0.6724 iph)  
At T = 2.52 2.50 hrs

**INPUT SUMMARY FOR W.S.: AU-29**

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.025 <u>0.0216</u> hr Area = 1.83 <u>1.23</u> ac

**OUTPUT SUMMARY**

Runoff depth = 0.1873 in  
Initial Abstraction = 0.6316 in  
Peak Flow = 0.29 0.20 cfs    (0.1558 0.1573 iph)  
At T = 2.50-hrs

**PEAK**  
**HYDROGRAPH GENERATION PROGRAM**

**INPUT SUMMARY FOR W.S.: AU-29A**

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.023 <u>0.020</u> hr Area = 4.24 <u>0.46</u> ac

**OUTPUT SUMMARY**

Runoff depth = 0.1873 in  
Initial Abstraction = 0.6316 in  
Peak Flow = 0.67 0.05 cfs    (0.1564 0.1016 iph)  
At T = 2.50 2.59 hrs

**INPUT SUMMARY FOR W.S.: AU-30**

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.029 hr Area = 0.49 ac

**OUTPUT SUMMARY**

Runoff depth = 0.1873 in  
Initial Abstraction = 0.6316 in  
Peak Flow = 0.08 cfs (0.1534 iph)  
At T = 2.51 hrs

Culvert	Dia (in.)	Type	Contributing Watersheds	Peak Q(cfs)	Slope (ft/ft)	Outlet Condition
C-21U	36	CMP	Right Fork Drainage	43.09 47.02	0.06	12" rip-rap
C-22U	20	CMP	AU-19, AU-25	4.33	0.06	4"rip-rap
C-23U	36	CMP	AU-36, AU-35,AU 34, AU-20, AU-26, C-24U <u>C-28U</u>	38.80 40.56	0.06	11" rip-rap
C-24U	32	CMP	AU-40, C-25U <u>C-26U</u>	35.81 34.72	0.06	10" rip-rap
C-25U	30	CMP	AD-17, C-26U	49.85	0.06	8" rip-rap
C-26U	30	CMP	AU-39, AU-32, AU-33, C-30U, C-34U	49.69 18.76	0.06	8" rip-rap
C-27U	15	CMP	AU-22, AU-28, AU-29A, AU-31, <u>C-31U</u>	2.68 0.71	0.06	4" rip-rap
C-28U	15	CMP	AU-34, C-29U	3.04 5.59	0.06	4" rip-rap
C-29U	15	CMP	AU-20, AU-21, AU-22, AU-25, AU-26, <u>AU-30</u>	2.77 5.32	0.06	3: rip-rap
C-30U	15	CMP	AU-21, AU-21, AU-30 <u>Abandoned In Place</u>	4.26	0.06	Soil
C-31U	12	CMP	AU-27, AU-29, AU-29A, <u>C-38U</u>	0.29 0.39	0.06	soil
C-32U	15	CMP	AU-22, AU-28, AU-29A	2.36	0.06	3" rip-rap
C-33U	24	CMP	AU-23, AU-24, AU-28A, AU-37	14.42 16.33	0.06	8" rip-rap
C-34U	24	CMP	AD-19, AU-31, AU-37, AU-38, C-31U, C-32U <u>AU-38, C-27U, C-33U</u>	17.86 18.19	0.06	8" rip-rap
C-35U	84	CMP	BEAR CREEK	412.70	0.06	48" rip-rap
C-36U	15	CMP	AU-27, AU-21 <u>Abandoned In Place</u>	4.18	0.11	3" rip-rap
C-37U	15	CMP	Abandoned In Place			
C-38U	15	CMP	AU-28	0.09 0.11	0.08	soil
C-39U	1512	CMP	AU-22,AU23A,C40U	2.271.57	0.180.06	6"rip rap <u>Soil</u>
C-40U	12	CMP	AU-23	0.64	0.001	soil

## Worksheet Worksheet for Circular Channel

### Project Description

Worksheet	C-21U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

### Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	36 in
Discharge	47.02 cfs

### Results

Depth	1.56 ft
Flow Area	3.7 ft <sup>2</sup>
Wetted	4.82 ft
Perimeter	
Top Width	3.00 ft
Critical Depth	2.23 ft
Percent Full	51.8 %
Critical Slope	0.020717 ft/ft
Velocity	12.71 ft/s
Velocity Head	2.51 ft
Specific	4.07 ft
Energy	
Froude	2.02
Number	
Maximum	95.19 cfs
Discharge	
Discharge Full	88.49 cfs
Slope Full	0.016940 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 12" m.d. riprap at outlet

B.C.

7G-75

7/04/06

## Worksheet Worksheet for Circular Channel

### Project Description

Worksheet	C-23U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

### Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	36 in
Discharge	40.56 cfs

### Results

Depth	1.43 ft
Flow Area	3.3 ft <sup>2</sup>
Wetted	4.56 ft
Perimeter	
Top Width	3.00 ft
Critical Depth	2.07 ft
Percent Full	47.5 %
Critical Slope	0.018580 ft/ft
Velocity	12.25 ft/s
Velocity Head	2.33 ft
Specific	3.76 ft
Energy	
Froude	2.05
Number	
Maximum	95.19 cfs
Discharge	
Discharge Full	88.49 cfs
Slope Full	0.012605 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 11" m.d. riprap at outlet

B.C.

7G-77

7/04/06

# Worksheet

## Worksheet for Circular Channel

### Project Description

Worksheet	C-24U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

### Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	32 in
Discharge	34.72 cfs

### Results

Depth	1.39 ft
Flow Area	2.5 ft <sup>2</sup>
Wetted	4.03 ft
Perimeter	
Top Width	2.66 ft
Critical Depth	1.98 ft
Percent Full	52.2 %
Critical Slope	0.021394 ft/ft
Velocity	11.78 ft/s
Velocity Head	2.16 ft
Specific	3.55 ft
Energy	
Froude	1.47
Number	
Maximum	69.53 cfs
Discharge	
Discharge Full	64.64 cfs
Slope Full	0.017311 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 10" m.d. riprap at outlet

B.C.

7G-78

7/04/06

# Worksheet

## Worksheet for Circular Channel

C-25U Replaced with C-26U

Project Description	
Worksheet	C-25U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	30 in
Discharge	19.85 cfs

Results	
Depth	1.04 ft
Flow Area	1.9 ft <sup>2</sup>
Wetted Perimeter	3.51 ft
Top Width	2.47 ft
Critical Depth	1.51 ft
Percent Full	41.8 %
Critical Slope	0.017249 ft/ft
Velocity	10.22 ft/s
Velocity Head	1.62 ft
Specific Energy	2.67 ft
Froude Number	2.03
Maximum Discharge	58.54 cfs
Discharge Full	54.42 cfs
Slope Full	0.007983 ft/ft
Flow Type	Supercritical

~~Minimum required riprap conditions = 8" m.d. riprap at outlet~~

B.C.

7G-79

7/04/06

# Worksheet

## Worksheet for Circular Channel

### Project Description

Worksheet	C-26U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

### Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	30 in
Discharge	18.76 cfs

### Results

Depth	1.01 ft
Flow Area	1.9 ft <sup>2</sup>
Wetted	3.45 ft
Perimeter	
Top Width	2.45 ft
Critical Depth	1.47 ft
Percent Full	40.5 %
Critical Slope	0.016875 ft/ft
Velocity	10.06 ft/s
Velocity Head	1.57 ft
Specific	2.59 ft
Energy	
Froude	2.04
Number	
Maximum	58.54 cfs
Discharge	
Discharge Full	54.42 cfs
Slope Full	0.007130 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 8" m.d. riprap at outlet

B.C.

7G-80

7/04/06

# Worksheet

## Worksheet for Circular Channel

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### Project Description

---

Worksheet	C-27U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

---

### Input Data

---

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	18 in
Discharge	0.71 cfs

---

### Results

---

Depth	0.23 ft
Flow Area	0.2 ft <sup>2</sup>
Wetted	1.21 ft
Perimeter	
Top Width	1.08 ft
Critical Depth	.31 ft
Percent Full	15.3 %
Critical Slope	0.017059 ft/ft
Velocity	4.13 ft/s
Velocity Head	.27 ft
Specific	0.50 ft
Energy	
Froude	1.83
Number	
Maximum	14.99 cfs
Discharge	
Discharge Full	13.94 cfs
Slope Full	0.000016 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 4" m.d. riprap at outlet

B.C.

7G-81

7/04/06

# Worksheet

## Worksheet for Circular Channel

### Project Description

Worksheet	C-28U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

### Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	18 in
Discharge	5.59 cfs

### Results

Depth	0.66 ft
Flow Area	0.80 ft <sup>2</sup>
Wetted	2.18 ft
Perimeter	
Top Width	1.49 ft
Critical Depth	0.91 ft
Percent Full	44.1 %
Critical Slope	0.020550 ft/ft
Velocity	7.45 ft/s
Velocity Head	0.86 ft
Specific	1.52 ft
Energy	
Froude	1.85
Number	
Maximum	14.99 cfs
Discharge	
Discharge Full	13.94 cfs
Slope Full	0.009653 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 4" m.d. riprap at outlet

B.C.

7G-82

7/04/06

# Worksheet

## Worksheet for Circular Channel

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### Project Description

---

Worksheet	C-29U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

---

### Input Data

---

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	18 in
Discharge	5.32 cfs

---

### Results

---

Depth	0.64 ft
Flow Area	0.7 ft <sup>2</sup>
Wetted	2.14 ft
Perimeter	
Top Width	1.48 ft
Critical Depth	0.89 ft
Percent Full	42.8 %
Critical Slope	0.020119 ft/ft
Velocity	7.36 ft/s
Velocity Head	0.84 ft
Specific	1.48 ft
Energy	
Froude	1.86
Number	
Maximum	14.99 cfs
Discharge	
Discharge Full	13.94 cfs
Slope Full	0.008743 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 3" m.d. riprap at outlet

B.C.

7G-83

7/04/06

# Worksheet

## Worksheet for Circular Channel

C-30U Abandoned In Place

### Project Description

Worksheet	C-30U
Flow-Element	Circular Channel
Method	Manning's Formula
Solve-For	Channel Depth

### Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 0.00
Diameter	15 in
Discharge	1.26 cfs

### Results

Depth	0.32 ft
Flow-Area	0.3 ft <sup>2</sup>
Wetted	1.34 ft
Perimeter	
Top Width	1.10 ft
Critical Depth	0.44 ft
Percent Full	25.9 %
Critical Slope	0.017902 ft/#
Velocity	4.99 ft/s
Velocity Head	0.39 ft
Specific	0.71 ft
Energy	
Froude	1.83
Number	
Maximum	9.22 cfs
Discharge	
Discharge-Full	8.57 cfs
Slope-Full	0.001297 ft/#
Flow-Type	Supercritical

B.C.

7G-84

7/04/06

# Worksheet

## Worksheet for Circular Channel

### Project Description

Worksheet	C-31U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

### Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	12 in
Discharge	0.39 cfs

### Results

Depth	0.19 ft
Flow Area	0.1 ft <sup>2</sup>
Wetted	0.91 ft
Perimeter	
Top Width	0.79 ft
Critical Depth	0.26 ft
Percent Full	19.4 %
Critical Slope	0.019205 ft/ft
Velocity	3.64 ft/s
Velocity Head	0.21 ft
Specific	0.40 ft
Energy	
Froude	1.74
Number	
Maximum	5.08 cfs
Discharge	
Discharge Full	4.73 cfs
Slope Full	0.000408 ft/ft
Flow Type	Supercriti cal

B.C.

7G-85

7/04/06

# Worksheet

## Worksheet for Circular Channel

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Project Description	
Worksheet	C-32U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coefficient	0.024
Slope	0.050 ft/ft
Diameter	18 in
Discharge	1.73 cfs

Results	
Depth	0.37 ft
Flow Area	0.3 ft <sup>2</sup>
Wetted Perimeter	1.59 ft
Top Width	1.30 ft
Critical Depth	0.49 ft
Percent Full	24.9 %
Critical Slope	0.016782 ft/ft
Velocity	5.03 ft/s
Velocity Head	0.39 ft
Specific Energy	0.77 ft
Froude Number	1.72
Maximum Discharge	13.69 cfs
Discharge Full	12.72 cfs
Slope Full	0.0000925 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 3" m.d. riprap at outlet

B.C.

7G-86

7/04/06

## Worksheet

### Worksheet for Circular Channel

#### Project Description

Worksheet	C-33U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

#### Input Data

Mannings Coefficient	0.024
Slope	0.024 ft/ft 000
Diameter	30 in
Discharge	16.33 cfs

#### Results

Depth	0.94 ft
Flow Area	1.7 ft <sup>2</sup>
Wetted	3.30 ft
Perimeter	
Top Width	2.42 ft
Critical Depth	1.37 ft
Percent Full	37.6 %
Critical Slope	0.016104 ft/ft
Velocity	9.69 ft/s
Velocity Head	1.47 ft
Specific	2.40 ft
Energy	
Froude	2.05
Number	
Maximum	37.02 cfs
Discharge	
Discharge Full	34.42 cfs
Slope Full	0.005403 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 8" m.d. riprap at outlet

B.C.

7G-87

7/04/06

## Worksheet Worksheet for Circular Channel

### Project Description

Worksheet	C-34U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

### Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	30 in
Discharge	18.19 cfs

### Results

Depth	1.00 ft
Flow Area	1.8 ft <sup>2</sup>
Wetted	3.41 ft
Perimeter	
Top Width	2.45 ft
Critical Depth	1.44 ft
Percent Full	39.8 %
Critical Slope	0.06684 ft/ft
Velocity	9.98 ft/s
Velocity Head	1.55 ft
Specific	2.54 ft
Energy	
Froude	2.04
Number	
Maximum	58.54 cfs
Discharge	
Discharge Full	54.42 cfs
Slope Full	0.006704 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 8" m.d. riprap at outlet

B.C.

7G-88

7/04/06

# Worksheet

## Worksheet for Circular Channel

C-36U Abandoned in place

### Project Description

Worksheet	C-36U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

### Input Data

Mannings Coefficient	0.024
Slope	0.110 ft/ft 000
Diameter	45 in
Discharge	1.18 cfs

### Results

Depth	0.27 ft
Flow Area	0.2 ft <sup>2</sup>
Wetted Perimeter	1.24 ft
Top Width	1.03 ft
Critical Depth	0.43 ft
Percent Full	21.5 %
Critical Slope	0.017833 ft/ft
Velocity	6.08 ft/s
Velocity Head	0.57 ft
Specific Energy	0.84 ft
Froude Number	2.46
Maximum Discharge	12.48 cfs
Discharge Full	11.60 cfs
Slope Full	0.001137 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 3" m.d. riprap at outlet

B.C.

7G-90

7/04/06

# Worksheet

## Worksheet for Circular Channel

### Project Description

Worksheet	C-38U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

### Input Data

Mannings Coefficient	0.024
Slope	0.080 ft/ft 000
Diameter	15 in
Discharge	0.11 cfs

### Results

Depth	0.09 ft
Flow Area	4.1e-2 ft <sup>2</sup>
Wetted	0.69 ft
Perimeter	
Top Width	0.66 ft
Critical Depth	0.13 ft
Percent Full	7.4 %
Critical Slope	0.020852 ft/ft
Velocity	2.67 ft/s
Velocity Head	0.11 ft
Specific	0.20 ft
Energy	
Froude	1.88
Number	
Maximum	10.65 cfs
Discharge	
Discharge Full	9.90 cfs
Slope Full	0.000010 ft/ft
Flow Type	Supercritical

B.C.

7G-92

7/04/06

# Worksheet

## Worksheet for Circular Channel

### Project Description

Worksheet	C-39U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

### Input Data

Mannings Coefficient	0.024
Slope	0.060000 ft/ft
Diameter	12 in
Discharge	1.57 cfs

### Results

Depth	0.40 ft
Flow Area	0.3 ft <sup>2</sup>
Wetted	1.36 ft
Perimeter	
Top Width	0.98 ft
Critical Depth	0.53 ft
Percent Full	39.7 %
Critical Slope	0.021536 ft/ft
Velocity	5.41 ft/s
Velocity Head	0.045 ft
Specific	0.085 ft
Energy	
Froude	1.75
Number	
Maximum	5.08 cfs
Discharge	
Discharge Full	4.73 cfs
Slope Full	0.006619 ft/ft
Flow Type	Supercriti cal

Minimum required riprap conditions = 6" m.d. riprap at outlet

B.C.

7G-93

7/04/06

# Worksheet

## Worksheet for Circular Channel

Intentionally left blank

### Project Description

Worksheet	C-40U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

### Input Data

Mannings Coefficient	0.024
Slope	0.001 ft/ft 000
Diameter	12 in
Discharge	0.64 cfs

### Results

Depth	0.87 ft
Flow-Area	0.7 ft <sup>2</sup>
Wetted	2.41 ft
Perimeter	
Top Width	0.67 ft
Critical Depth	0.33 ft
Percent Full	87.2 %
Critical Slope	0.01917 ft/ft 4
Velocity	0.88 ft/s
Velocity Head	0.01 ft
Specific Energy	0.88 ft
Froude Number	0.15
Maximum Discharge	0.66 cfs
Discharge Full	0.64 cfs
Slope Full	0.00110 ft/ft 0
Flow Type	Subcritic al

B.C.

7G-94

7/04/06

# Worksheet

## Worksheet for Circular Channel

Intentionally left blank

### Project Description

Worksheet	C-13D
Flow-Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

### Input Data

Mannings Coefficient	0.024
Slope	0.070 ft/ft 0.00
Diameter	42 in
Discharge	0.99 cfs

### Results

Depth	0.30 ft
Flow-Area	0.2 ft <sup>2</sup>
Wetted	1.16 ft
Perimeter	
Top-Width	0.92 ft
Critical-Depth	0.42 ft
Percent Full	29.8 %
Critical Slope	0.019770 ft/ft
Velocity	5.03 ft/s
Velocity Head	0.39 ft
Specific	0.69 ft
Energy	
Froude	1.91
Number	
Maximum	5.49 cfs
Discharge	
Discharge Full	5.11 cfs
Slope Full	0.002632 ft/ft
Flow Type	Supercritical

B.C.

7G-107

7/04/06

DITCH	CHANNEL SLOPE %	CONTRIBUTING WATERSHED	PEAK Q (cfs)	BANK AND BOTTOM DESC.	MANNING'S $\eta^{(a)}$
D-23U	19 Av	AU-36	.12	soil	0.03
D-24U	14 Av	AU-35, C-28U	.13 5.72	soil	0.03
D-25U	16 Av	AD-17	.16	soil	0.03
D-26U	24 Av	AU-32	.28	soil	0.03
D-27U	13 Min, 30 Max	AU-31, C-31U	.32 0.71	Soil bedrock	0.03
D-28U	14 Av	AU-33	.11	soil	0.03
D-29U	8 Av	AU-34	.27	soil	0.03
D-30U	13 Av	AU-25	.30	soil	0.03
D-31U	12 Av	AU-20, AU-26, AU-30, C-37U	2.47 5.32	bedrock	0.03
D-32U	17 Av	AU-30	.08	soil	0.03
D-33U	18 Av	AU-27, AU-28, AU-29, AU-29A	.20 0.39	soil	0.03
D-34U	11 Av	AU-24, AU-23, AU-28A	1.66 2.69	soil	0.03
D-35U	10 Av	AU-29, AU-27	0.29 0.23	soil	0.03
D-36U	8 Av	AU-27	0.03	soil	0.03
D-37U	8 Av	AU-21, AU-26, AU-22	1.25 3.76	soil	0.03
D-38U	12 Min, 20 Max	AU-21, AU-22	1.15 2.68	$D_{50} = 3"$ , soil	0.03
D-39U	10 Av	AU-28	0.09 0.11	soil	0.03
D-40U	9 Av	AU-28A, AU-39U	2.41 0.12	$D_{50} = 3"$ soil	0.03
D-41U	15 Av	AU-22, AU-23 <sup>a</sup> , AU-40U	2.27	$D_{50} = 4"$	0.03
D-42U	36 Av, 63 Max	AU-23A AU-22	0.04 1.57	soil	0.03
D-43U	20 Min, 45 Max	AU-23	0.64 0.91	$D_{50} = 5"$ , soil	0.03

- a) Based on tables from Barfield et al (1981) and the equation  $\eta = .0395(D_{50})^{1/6}$ ; (D in ft)  
 b) Peak Q for misc. road drainage assumed to be 1.0 cfs based on similar disturbed areas.  
 (c) See table 7.2-10 for summary of diversion ditch calculation

## Worksheet

### Worksheet for Trapezoidal Channel

#### Project Description

Worksheet D-24U  
 Flow Element Trapezoidal  
 Channel  
 Method Manning's  
 Formula  
 Solve For Channel  
 Depth

#### Input Data

Mannings Coefficient	0.030
Slope	0.140 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	05.72 cfs

#### Results

Depth	0.83 ft
Flow Area	0.7 ft <sup>2</sup>
Wetted Perimeter	2.36 ft
Top Width	1.67 ft
Critical Depth	1.15 ft
Critical Slope	0.025017 ft/ft
Velocity	8.21 ft/s
Velocity	1.05 ft
Head	
Specific Energy	1.88 ft
Froude Number	2.24
Flow Type	Supercritical

Use Minimum Depth = 1.0 ft  
 Velocity 8.21 fps

Minimum Freeboard = 0.17 ft  
 No riprap required /3" riprap below  
 confluence with C-28U

B.C.

7G-183

7/04/06

# Worksheet

## Worksheet for Trapezoidal Channel

### Project Description

Worksheet D-27U  
 Flow Element Trapezoidal  
 Channel  
 Method Manning's  
 Formula  
 Solve For Channel  
 Depth

### Input Data

Mannings Coefficient	0.030
Slope	0.130 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.50 ft
Discharge	0.71 cfs

### Results

Depth	0.20 ft
Flow Area	0.2 ft <sup>2</sup>
Wetted Perimeter	1.21 ft
Top Width	1.09 ft
Critical Depth	0.30 ft
Critical Slope	0.026331 ft/ft
Velocity	4.56 ft/s
Velocity	0.32 ft
Head	
Specific Energy	0.52 ft
Froude Number	2.12
Flow Type	Supercritical

Use Minimum Depth = 0.5 ft  
Velocity < 5 fps

Minimum Freeboard = 0.37 ft  
No riprap required

B.C.

7G-186

7/04/06

## Worksheet Worksheet for Trapezoidal Channel

### Project Description

Worksheet	D-27U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

### Input Data

Mannings Coefficient	0.030
Slope	0.300 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.50 ft
Discharge	0.71 cfs

### Results

Depth	0.16 ft
Flow Area	0.1 ft <sup>2</sup>
Wetted Perimeter	1.06 ft
Top Width	0.97 ft
Critical Depth	0.97 ft
Critical Slope	0.026332 ft/ft
Velocity	6.16 ft/s
Velocity	0.59 ft
Head	
Specific Energy	0.75 ft
Froude Number	3.15
Flow Type	Supercritical

B.C.

7G-187

7/04/06

# Worksheet

## Worksheet for Trapezoidal Channel

### Project Description

Worksheet	D-31U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

### Input Data

Mannings Coefficient	0.030
Slope	0.120 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	5.32 cfs

### Results

Depth	0.69 ft
Flow Area	0.7 ft <sup>2</sup>
Wetted	2.48 ft
Perimeter	
Top Width	2.06 ft
Critical Depth	0.95 ft
Critical Slope	0.021493 ft/ft
Velocity	7.47 ft/s
Velocity	0.87 ft
Head	
Specific	1.56 ft
Energy	
Froude	2.24
Number	
Flow Type	Supercritical

Notes: Use Min. Depth = 1.0 ft: Minimum Freeboard = 0.31 ft.  
Velocity = 7.47 fps: Use channel bottom is bedrock

B.C.

7G-191

7/04/06

# Worksheet

## Worksheet for Trapezoidal Channel

### Project Description

Worksheet	D-33U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

### Input Data

Mannings Coefficient	0.030
Slope	0.180 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.39 cfs

### Results

Depth	0.28 ft
Flow Area	0.1 ft <sup>2</sup>
Wetted	0.80 ft
Perimeter	
Top Width	0.56 ft
Critical Depth	0.38 ft
Critical Slope	0.036121 ft/ft
Velocity	4.52 ft/s
Velocity	0.32 ft
Head	
Specific	0.60 ft
Energy	
Froude	2.12
Number	
Flow Type	Supercritical

Notes: Use Min. Depth = 0.50 ft; Minimum Freeboard = 0.22 ft.  
 Velocity < 5 fps: No riprap required

B.C.

7G-193

7/04/06

# Worksheet

## Worksheet for Trapezoidal Channel

### Project Description

Worksheet	D-34U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

### Input Data

Mannings Coefficient	0.030
Slope	0.110 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	1.00 ft
Discharge	2.69 cfs

### Results

Depth	0.31 ft
Flow Area	0.50 ft <sup>2</sup>
Wetted	2.12 ft
Perimeter	
Top Width	1.93 ft
Critical Depth	0.48 ft
Critical Slope	0.021912 ft/ft
Velocity	5.13 ft/s
Velocity	0.54 ft
Head	
Specific Energy	0.85 ft
Froude	2.14
Number	
Flow Type	Supercritical

Notes: Use Min. Depth = 0.58 ft; Minimum Freeboard = 0.27 ft.  
Velocity = 5 fps; No riprap required

B.C.

7G-194

7/04/06

# Worksheet

## Worksheet for Trapezoidal Channel

### Project Description

Worksheet	D-35U
Flow Element	Trapezoidal
	Channel
Method	Manning's
	Formula
Solve For	Channel
	Depth

### Input Data

Mannings Coefficient	0.030
Slope	0.010 ft/ft 000
Left Side Slope	.67 V : H
Right Side Slope	.67 V : H
Bottom Width	0.00 ft
Discharge	0.23 cfs

### Results

Depth	0.34 ft
Flow Area	0.2 ft <sup>2</sup>
Wetted Perimeter	1.22 ft
Top Width	1.01 ft
Critical Depth	0.27 ft
Critical Slope	0.032673 ft/ ft
Velocity	1.34 ft/ s
Velocity Head	0.03 ft
Specific Energy	0.37 ft
Froude Number	0.57
Flow Type	Subcritical

Use Minimum Depth = 1.0 0.75 ft  
 Velocity < 5 fps

Minimum Freeboard = 0.55 0.41 ft  
 No riprap required

B.C.

7G-195

7/04/06

## Worksheet

### Worksheet for Trapezoidal Channel

#### Project Description

Worksheet D-37U  
 Flow Element Trapezoidal  
 Channel  
 Method Manning's  
 Formula  
 Solve For Channel  
 Depth

#### Input Data

Mannings Coefficient	0.030
Slope	0.080000 ft/ft
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	3.76 cfs

#### Results

Depth	0.65 ft
Flow Area	0.6 ft <sup>2</sup>
Wetted Perimeter	2.35 ft
Top Width	1.95 ft
Critical Depth	0.83 ft
Critical Slope	0.022510 ft/ft
Velocity	5.88 ft/s
Velocity	0.54 ft
Head	
Specific Energy	1.19 ft
Froude Number	1.81
Flow Type	Supercritical

Use Minimum Depth = 1.0 ft  
 Velocity < 5.88 fps

Minimum Freeboard = 0.30 0.35 ft  
 Use D<sub>50</sub> = No rip rap required 3"

B.C.

7G-197

7/04/06

## Worksheet

### Worksheet for Trapezoidal Channel

#### Project Description

Worksheet	D-38U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

#### Input Data

Mannings Coefficient	0.030
Slope	070000 ft/ft
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	2.68 cfs

#### Results

Depth	0.59 ft
Flow Area	0.5 ft <sup>2</sup>
Wetted	2.12 ft
Perimeter	
Top Width	1.76 ft
Critical Depth	0.73 ft
Critical Slope	0.023550 ft/ft
Velocity	5.14 ft/s
Velocity	0.41 ft
Head	
Specific	1.00 ft
Energy	
Froude	1.67
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.67 1.0 ft  
 Max Slope = 15%

Minimum Freeboard = 0.22 0.48 ft  
 Use D<sub>50</sub> = 3" No rip-rap required

# Worksheet

## Worksheet for Trapezoidal Channel

### Project Description

Worksheet D-39U  
 Flow Element Trapezoidal  
 Channel  
 Method Manning's  
 Formula  
 Solve For Channel  
 Depth

### Input Data

Mannings Coefficient	0.030
Slope	0.100 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	0.11 cfs

### Results

Depth	0.17 ft
Flow Area	4.2e-2 ft <sup>2</sup>
Wetted Perimeter	0.60 ft
Top Width	0.50 ft
Critical Depth	0.20 ft
Critical Slope	0.036048 ft/ft
Velocity	2.64 ft/s
Velocity	0.11 ft
Head	
Specific Energy	0.28 ft
Froude Number	1.61
Flow Type	Supercritical

Use Minimum Depth = 0.5 ft  
Velocity <5 fps

Minimum Freeboard = 0.34 0.33 ft  
No riprap required

B.C.

7G-199

7/04/06

# Worksheet

## Worksheet for Trapezoidal Channel

### Project Description

Worksheet D-40U  
 Flow Element Trapezoidal  
 Channel  
 Method Manning's  
 Formula  
 Solve For Channel  
 Depth

### Input Data

Mannings Coefficient	0.030
Slope	0.090 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	0.12 cfs

### Results

Depth	0.18 ft
Flow Area	4.6e-2 ft <sup>2</sup>
Wetted Perimeter	0.63 ft
Top Width	0.53 ft
Critical Depth	0.21 ft
Critical Slope	0.035631 ft/ft
Velocity	2601 ft/s
Velocity	0.10 ft
Head	
Specific Energy	0.28
Froude Number	1.54
Flow Type	Supercritical

Use Minimum Depth = 0.75 0.50 ft  
 Velocity = 55.61 fps <5

Minimum Freeboard = 0.09 0.32 ft  
 Use d50=30' No riprap required

B.C.

7G-200

7/04/06

# Worksheet

## Worksheet for Trapezoidal Channel

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### Project Description

Worksheet	D-41U
Flow-Element	Trapezoidal Channel
Method	Manning's Formula
Solve-For	Channel Depth

### Input Data

Mannings Coefficient	0.030
Slope	0.150 ft/ft 000
Left Side Slope	1.00 V: H
Right Side Slope	1.00 V: H
Bottom Width	0.00 ft
Discharge	2.27 cfs

### Results

Depth	0.58 ft
Flow Area	0.3 ft <sup>2</sup>
Wetted	1.65 ft
Perimeter	
Top Width	1.17 ft
Critical Depth	0.80 ft
Critical Slope	0.028298 ft/ft
Velocity	6.69 ft/s
Velocity	0.70 ft
Head	
Specific	1.28 ft
Energy	
Froude	2.19
Number	
Flow Type	Supercritical

Use Minimum Depth = 1.0 ft  
Velocity = 6.69 fps

Minimum Freeboard = 0.42 ft  
Use D<sub>50</sub> = 4"

B.C.

7G-201

7/04/06

# Worksheet

## Worksheet for Trapezoidal Channel

### Project Description

Worksheet	D-42U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

### Input Data

Mannings Coefficient	0.030
Slope	041000 ft/ft
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	2.00 ft
Discharge	1.57 cfs

### Results

Depth	0.11 ft
Flow Area	0.2 ft <sup>2</sup>
Wetted Perimeter	2.31 ft
Top Width	2.22 ft
Critical Depth	0.26 ft
Critical Slope	0.023852 ft/ft
Velocity	6.82 ft/s
Velocity	0.72 ft
Head	
Specific Energy	0.83 ft
Froude Number	3.73
Flow Type	Supercritical

Use Minimum Depth = 0.25 ft  
Velocity 6.75 6.82

Minimum Freeboard = 0.15 0.14 ft  
No rip-rap required Use D<sub>50</sub> = 3"

B.C.

7G-202

7/04/06

## Worksheet

### Worksheet for Trapezoidal Channel

#### Project Description

Worksheet D-43U  
 Flow Element Trapezoidal  
 Channel  
 Method Manning's  
 Formula  
 Solve For Channel  
 Depth

#### Input Data

Mannings Coefficient	0.030
Slope	0.220000 ft/ft
Left Side Slope	0.50 V : H
Right Side Slope	0.50 V : H
Bottom Width	2.00 ft
Discharge	0.91 cfs

#### Results

Depth	0.09 ft
Flow Area	0.2 ft <sup>2</sup>
Wetted Perimeter	2.42 ft
Top Width	2.37 ft
Critical Depth	0.17 ft
Critical Slope	0.025566 ft/ft
Velocity	4.47 ft/s
Velocity	0.31 ft
Head	
Specific Energy	0.40 ft
Froude Number	2.69
Flow Type	Supercritical

Use Minimum Depth = 0.5 0.25 ft  
 Velocity = 6.96 <5 fps

Minimum Freeboard = 0.29 0.16 ft  
 Use d50=5" No riprap required

B.C.

7G-203

7/04/06

## **Appendix 7-K**

### **Alternate Sediment Control Areas And Small Area Exemptions**

### **BTCA Area K - Outslope of Fill Area Around C-15U**

This area is approx 0.32 acres, and includes the fill outslope of the lower Tank Seam Access Road around culvert C-15U (Plate 7-1E). The estimated volume of runoff from this area is 0.04 acre-ft, with a maximum slope length of 90 ft. Erosion and runoff will be controlled by the placement of erosion control matting on the slope, which will be maintained. To prevent excess water from crossing or saturating the fill slope, a berm will be maintained along the outer edge of the road, and the road will be sloped to drain water away from the slope.

### **BTCA Area L – Outslope of Lower WHR Tank Seam Access Road**

This includes two areas along the lower portion of the WHR Tank Seam Access Road. This first one is just below the ~~first~~ switchback and is approximately 0.05 0.26 acres. The second one is 200 feet past the first switchback and is approximately 0.02 0.11. The estimated volume of runoff from these areas is less than 0.01 0.02 acre-ft, with a maximum slope length of 40 60 feet. Erosion and runoff will be controlled by the placement of erosion control matting on the slope, which will be maintained. The area will also be seeded and revegetated after construction and natural vegetation will be used for soil and erosion control during port-mining use. These areas are shown on ~~Plate 3-2G~~ and Plate 7-1G.

### **BTCA Area M - Outslope of Fill Area Around C-16U**

This area is approx 0.091 acres, and includes the fill outslope of the lower Tank Seam Access Road around culvert C-16U (Plate 7-1E). The estimated volume of runoff from this area is 0.011 acre-ft, with a maximum slope length of 50 ft. Erosion will be controlled by the placement of erosion control matting on the slope, which will be maintained. To prevent excess water from crossing or saturating into the slope, a berm will be maintained along the outer edge of the road above the slope and the road will be sloped to drain water away from the fill slope.

### **BTCA Area N – Outslope of Fill Area Along WHR Tank Seam Access Road**

This ~~eonsist~~ area consists of approximately 0.232 acres located below the second switchback on the WHR Tank Seam Access Road and ~~0.269~~ 0.141 acres located on the slope just below the hunting cabin turn-off (Plate 7-1 G). The estimated volume of runoff from the first area is 0.029 acre-ft, with a maximum slope length of 76 feet. The estimated volume of runoff from the second area is ~~0.034~~ 0.010 acre-ft, with a maximum slope length of ~~78~~ 56 feet. Erosion will be controlled by the placement of erosion control matting on the slope, which will be maintained. To prevent excess water from crossing or saturating into the slope, a berm will be maintained along the outer edge of the road above the slope and the road will be sloped to drain water away from the fill slope.

### **BTCA Area Q - Upper Tank Seam Access Road Outslope Below D-18U**

This area is approx 0.089 acres. It includes the outslope adjacent to ditch D-18U (Plate 7-1E). The total runoff volume from this area is estimated to be 0.011 acre-ft. Erosion will be controlled by the placement of erosion control matting on the slope, which will be maintained. To prevent water from crossing or saturating the slope, berms will be placed along the road, and the road sloped to drain water away from the fill slope.

### **BTCA Area S - Outslope of Fill Area Around C-18U, C-19U and C-20U**

This area is approx 0.123 acres, and includes the fill outslope of the upper Tank Seam Access Road around culverts C-18U, C-19U and C-20U (Plate 7-1E). The estimated volume of runoff from this area is 0.015 acre-ft, with a maximum slope length of 35 ft. Erosion and runoff will be controlled by the placement of erosion control matting on the slope, which will be maintained. To prevent excess water from crossing or saturating the fill slope, a berm will be maintained along the outside edge of the road and the road will be sloped to drain water away from the fill slope.

### **BTCA Area T – WHR Tank Seam Topsoil Stockpile Area**

This area consists of 0.31 ~~0.23~~ acres, shown on Plate 7-1G. The topsoil stockpile will be totally contained by a berm to prevent any topsoil from being eroded from the stockpile.

## **BTCA Area "Z" – WHR Tank Seam Portal Pad Area**

This area consists of 0.47 0.32 acres and is the Wild Horse Ridge Tank Seam Portal Pad as shown on plate 7-1G. This area is controlled by Catch basin 3 at the lower end of the pad. A berm will be placed around the outside of the pad and it will be sloped away from the road to prevent any water from draining down the road.

Catch Basin 3 will contain runoff from watershed areas AD-20. Runoff calculations are shown in Appendix 7-G. The modified universal soil loss equation is:

$$A = R \times K \times LS \times VM.$$

Where:

A = Amount of soil loss per unit area

R = Rainfall factor = 16 (See Appendix 7-F)

K = Soil Erodibility Factor = 0.1 (See Appendix 7-F)

LS = Topographic factor (See equation, App. 7-F)

VM = Soil Erodibility Factor

The catch basin will be inspected at least quarterly for stability, erosion, and capacity. Any problems noted will be corrected as soon as is practical. The catch basin will be cleaned as necessary to ensure adequate storage capacity to completely contain the volumes as shown in the designs.

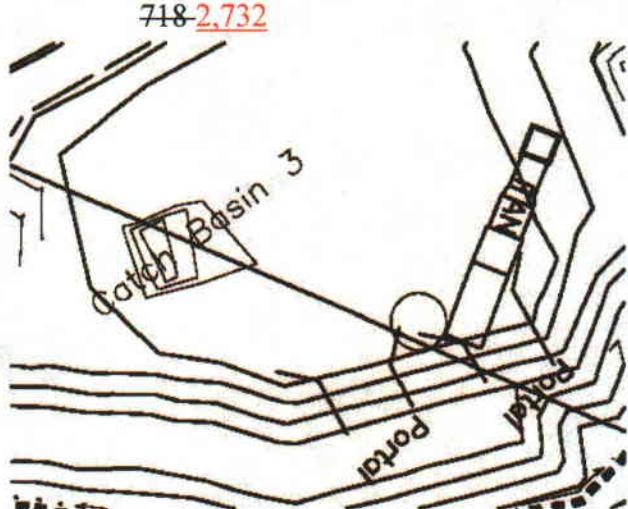
Table 7K-3 Catch Basin 3 Design

Catch Basin No.	3
Watershed	AD-20
Area (acres)	0.47 <u>0.32</u>
Peak Flow Q (in)	0.32 <u>0.16</u>
Soil Erodibility (tons/ac/EI)	1.0 <u>1.2</u> (conservative)
Runoff Volume (cu ft)	546 <u>186</u>
Topographic factor	8.3 <u>2.77</u>
Soil Loss (Tons/ac-year)	13.3 <u>5.32</u>
Soil Volume - 3 year capacity (cu ft)	375 <u>102</u>
Design Volume	718 <u>2,372</u>

Stage-CapacityBasin Information

Elevation	Area (sq ft)	Vol (cu ft)
7880 <u>7844</u>	359 <u>0</u>	-----
		<u>20.5</u>
7878 <u>7845</u>	223 <u>41</u>	446
		<u>116.5</u>
7876 <u>7846</u>	110 <u>192</u>	220
		<u>282.5</u>
7874 <u>7847</u>	26 <u>373</u>	52
		<u>535.5</u>
7848	698	<u>853.5</u>
7849	1009	<u>563.5</u>
7849.5	1245	
Total Volume		718 <u>2,372</u>

Bottom of Basin Elev: 7874 7844  
 Spillway Elevation: 7800 7849.5  
 Top of Dam Elev: 7880.5 7850  
 Required Volume: 375 102



## **980 Loader Cycle Time**

(From Cat Performance Handbook)	0.55 min
a. 3/4 inch to 6 inch	0.00 min
b. Pile (10 ft or less)	+ 0.01 min
c. 3/4 inch to 6 inch	- 0.04 min
	<u>0.52 min</u>

(60 min/hr)/(0.52 min/cycle) = 115.4 cycles/hr

Efficiency 50 min/hr - (115.4 cycles/hr)(6 cu yd/cycle)(50 min/60 min) = 577 cu yd/hr (96 cycles/hr)

## **Summary of Reclamation Cost Estimate**

### Direct Costs

a. Seal Portals and Backfill	\$ 112,500
b. Removal of Structures	\$ 210,403
c. Soil Placement and Ripping	<u>\$ 178,617</u> <del>165,965</del>
d. Channel Restoration	\$ 403,728
e. Revegetation	\$ 462,968
f. Monitor Well Plugging	<u>\$ 5,000</u>

Total Direct Costs: \$ 1,373,216 ~~1,360,564~~

### Indirect Costs

g. Maintenance and Monitoring (10%)	<u>\$ 137,322</u> <del>136,056</del>
h. Contingency (5%)	<u>\$ 68,661</u> <del>68,028</del>
i. Engineering Redesign (2.5%)	<u>\$ 34,330</u> <del>34,014</del>
j. Mobilization and Demobilization (5%)	<u>\$ 68,661</u> <del>68,028</del>
k. Contract Management Fee (2.5%)	<u>\$ 34,330</u> <del>34,014</del>

Total Indirect Costs: \$ 343,304~~340,141~~

**Total Reclamation Cost (2001 dollars)** \$ 1,716,520~~1,700,705~~

<u>Escalated Values</u>	<u>Escalation Factor</u>
2002 - 1,770,075 <u>1,753,767</u>	3.12% (est)
2003 - 1,825,302 <u>1,808,485</u>	3.12% (est)
2004 - 1,882,251 <u>1,864,909</u>	3.12% (est)
2005 - 1,940,978 <u>1,923,094</u>	3.12% (est)

The total bond currently posted, rounded to the nearest \$1,000, is **\$1,825,000**.

Scale House and Sediment Pond B (TS-3)

See Appendix 3L, Table 3L-2

Cut Subtotal	1,454 cu yds
Fill Subtotal	1,454 cu yds

Sediment Pond "A" (TS-4)

See Appendix 3-L, Table 3L-3.

Cut (350 sq ft) x (120ft) = 42,000 cu ft =	3,460 cu yds
Fill (350 sq ft) x (120ft) = 42,000 cu ft =	3,460 cu yds

Shower House and Sediment Pond C (TS-9)

See Appendix 3-L, Table 3L-8.

Cut (500 sq ft) x (185ft) = 92,500 cu ft =	5,851 cu yds
Fill (500 sq ft) x (185ft) = 92,500 cu ft =	5,851 cu yds

Wild Horse Ridge (TS-12 thru TS-15)

See Appendix 3-O, Table 3O-2, 3 & 4

Cut Subtotal =	23,641 cu yds
Fill Subtotal =	23,641 cu yds

Note: Approximately 12,500 cu yds of the Wild Horse Ridge volume will be regraded using a D9 dozer, and the remaining volume will be regraded using a 330BL Excavator.

Wild Horse Ridge Tank Seam (TS-16 thru TS-17)

See Appendix 3-P.

Cut Subtotal	11,089 <u>15,055</u> cu yds
Fill Subtotal	11,089 <u>15,055</u> cu yds

Cut Total =	112,025 cu yds
Fill Total =	112,025 cu yds

## SOIL PLACEMENT

Areas	Time	Earth			Equipment		
		Cost	Moved	Cu Yds	Used	Cost/hr	(hrs)
Tank Seam Access Road & Portal Pad (TS-10 & TS-11) Fill		Cut 20,310		20,310 330BL		\$153.13	20.2 \$ 3,093
		Hauled		10,661			
Upper Storage Pad (TS-8)	Cut	3,666 Fill		330BL 7,022		\$153.13	14.6 \$ 2,236
Portal Pad Area & Road (TS-7)		Cut Fill	6,445 18,037	330BL		\$153.13	37.7 \$ 5,773
Portal Access Road (TS-6)	Cut	8,126 Fill Excess Cut		330BL 5,573 2,553		\$153.13	11.65 \$ 1,784
Coal Storage Pad (TS-5)		Cut Fill Excess Cut	40,585 25,157 15,428	D9 Cat		\$190.80	50.3 \$ 9,597
Scale House/ Sed Pond B (TS-3)		Cut Fill	1,454 1,454	D9 Cat		\$190.80	2.9 \$ 553
Sediment Pond "A" (TS-4)	Cut	3,460 Fill		D9 Cat 3,460		\$190.80	6.9 \$ 1,317
Shower House/ Sed Pond C (TS-9)	Cut	5,851 Fill		D9 Cat 5,851		\$190.80	11.7 \$ 2,232
Wild Horse Ridge Area*** (TS-12 thru TS-15)	Cut	11,141 12,500 Fill		330BL D9 Cat 23,641		\$153.13 \$190.80	23.3 \$ 3,568 25.0 \$ 4,770
Wild Horse Ridge Tank Seam (TS-16 thru TS-17)	Cut Fill	1,016 1,760 11,089 15,055		D9 Cat 10,073 13,295 330BL		\$153.13 \$190.80	1.87 3.2 \$ 286 490 20.1 26.5 \$ 3,835 5.056
Totals		Cut Fill	110,462 110,708			219.82 227.52 \$ 39,044 40,469 (27.48 28.44 days)	

\*See Appendix 3-L and the following page.

\*\*Excess Cut will be hauled from TS-5 and TS-6 to TS-7 and TS-8, as discussed in Appendix 3-L.

\*\*\*Wild Horse Ridge material being relocated with the excavator will be hauled an average distance of 200 ft, as shown on the following pages.

Hauling =  $(12.38 \text{ min})(\text{hr}/60 \text{ min})(217)/(3 \text{ trucks}) = 14.9 \text{ hrs} = 1.9 \text{ days}$  (concurrent w/soil placement)  
 Round trip 2 =  $5.88 + 2(7.29) = 20.46 \text{ min.}$ ; Number of loads =  $(4,860 \text{ cu yd})/(10 \text{ cu yd truck}) = 486$   
 Loads  
 Hauling =  $(20.46 \text{ min}) (\text{hr}/60 \text{ min})(486)/(3 \text{ trucks}) = 55.2 \text{ hrs} = 6.9 \text{ days}$  (concurrent w/soil placement)

980 loader cost = $(\$142.77/\text{hr}) (40.6 + 14.9 + 55.2 \text{ hrs}) =$	$\$15,805$
Dump Truck cost = $(\$68.38/\text{hr}) (40.6 + 14.9 + 55.2 \text{ hrs}) (3 \text{ trucks}) =$	$\$23,788$
	$\$39,593$

#### Moving Excavator material for WHR Tank Seam regrading.

Avg. Distance = 390 ft = 0.07 miles @ avg. Speed of 7 MPH; haul time = 0.49 min.  
 Round trip time for 1 truck load (980 Loader) =  $5.88 + 2(0.49) = 6.86 \text{ min.}$   
 Number of loads =  $(10,095 \text{ 13,295 cu yd}) / (10 \text{ cu yd truck}) = 1,110 \text{ 1,330 loads}$   
 Hauling =  $(6.86 \text{ min})(\text{hr}/60 \text{ min})(1,110 \text{ 1,330 loads})/(3 \text{ trucks}) = 42.3 \text{ 50.7 hrs} = 5.3 \text{ 6.3 days}$   
 (concurrent w/soil placement)

980 loader cost = $(\$142.77/\text{hr}) (42.3 \text{ 50.7 hrs}) =$	$\$6,039 \text{ 7,238}$
Dump Truck cost = $(\$68.38/\text{hr}) (42.3 \text{ 50.7 hrs}) (3 \text{ trucks}) =$	$\$8,677 \text{ 10,401}$
	$\$14,716 \text{ 17,639}$

<b>Cost Subtotal</b>	<b><math>\\$ 97,316 \text{ 100,239}</math></b>
<b>Time Subtotal</b>	<b><math>9.9 \text{ 10.9 days}</math></b>

#### Hauling Material to Fill Borehole

10,560 cu yd will need to be hauled from the Blind Canyon Seam portal.  
 Round trip time:

Loader haul time = 0.3 miles @ 7 mph x 2 loads = 5.14 min. to haul  
 Loader cycle time = 2 cycles/(106 cycles/hr) = 1.13 min. to load  
 Truck haul time = 1.1 miles @ 7 mph = 9.43 min.

Total cycle time = 15.70 min.

Number of loads =  $10,560 \text{ cu yd}/10 \text{ cu yd truck} = 1,056 \text{ loads}$   
 980 Loader time =  $(15.7 \text{ min}) (\text{hr}/60 \text{ min}) (1,056 \text{ loads}) / 13 \text{ trucks} = 21.2 \text{ hrs.}$   
 = 2.65 days (concurrent with soil placement)

CAT 330BL cost = $(\$153.13/\text{hr}) (21.2 \text{ hrs}) =$	$\$3,384$
980 Loader cost = $(\$142.77/\text{hr}) (21.2 \text{ hrs}) =$	$\$3,027$
Dump Truck cost = $(\$68.38/\text{hr}) (21.2 \text{ hrs}) (13 \text{ trucks}) =$	$\$18,846$
	$\$ 25,257$

<b>Cost Subtotal</b>	<b><math>\\$ 25,257</math></b>
<b>Time Subtotal</b>	<b><math>2.65 \text{ days}</math></b>

Soil Placement Cost Subtotal =	$\$ 39,044 \text{ 40,469}$
Hauling Excess Cut Cost Subtotal =	$\$ 97,316 \text{ 100,239}$
Filling Borehole Cost Subtotal =	$\$ 25,257$

<b>Cost Total</b>	<b><math>\\$178,617 \text{ 165,965}</math></b>
<b>Time Total</b>	<b><math>36.2 \text{ 31.5}</math></b>